


Oral health and dental anxiety in a German practice-based sample

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Abstract

Objective Does dental anxiety have an effect on dental and periodontal health?

Methods Survey data was collected from $n = 200$ adults (53 % females, average age 49 years) in a cross-sectional study. Dental anxiety was measured with the modified dental anxiety scale (MDAS, score 1–5, the greater the score, the greater the anxiety). Clinical parameters including probing depth (PD), clinical attachment level (CAL), plaque index (SLI), and bleeding on probing (BoP) as well as the DMFT index were recorded and statistically analyzed.

Results Rating of dental anxiety was higher in women than in men (65 vs 35 %). Subjects with higher MDAS values visited the dentist less frequently ($p = 0.001$) and had more decay (DT 6.7 ± 4.2 vs 1.7 ± 2.4 ; $p < 0.001$) but fewer filled teeth than subjects with lower ratings of dental anxiety (FT 7.1 ± 4.5 vs 9.8 ± 5.7 ; $p = 0.042$). There were no differences in PD or CAL between subjects with or without dental anxiety, while patients with higher MDAS value showed significantly more BoP (50 ± 19 vs 34 ± 20 %; $p = 0.002$) than patients with low MDAS scores (no or low dental anxiety).

Conclusions Patients with higher ratings of dental anxiety had significantly more caries experience and gingivitis. Therefore, dental anxiety is associated with negative effect on dental and periodontal health.

Clinical relevance Identifying patients with high dental anxiety and helping to manage this anxiety has important implications to improve oral health in adults. The MDAS appears to be an easy and efficient tool that can be used to identify patients with dental anxiety in dental practices.

Keywords Dental anxiety · MDAS · Periodontal disease · DMFT

Introduction

Dental anxiety affects numerous patients in developed countries [1], with a range of 5 to 42 % [2, 3] of the population. A previous survey in a German population reported an incidence of 11 % of dental phobia [4]. It is well documented that dental fear has a significant impact on dental care utilization behaviors [5]. Population-based studies have demonstrated that most patients with dental anxiety avoid necessary dental care, and dental fear may be one of the main reasons for missed and canceled appointments [6].

The development of dental anxiety is multi-factorial. Dental anxiety can be a conditioned reaction to previous aversive dental experiences [7], including both painful and traumatic experiences during dental treatment and unpleasant dentist contact [8]. General fearfulness is another reported etiological factor [9]. Fear of pain, being closed in, powerlessness, loss of control, unpredictable events, and embarrassment are contributing factors in the development of dental anxiety [10]. If parents suffer from dental anxiety, this might have an effect on the behavioral development of their children [11].

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Berggren [12] described a vicious cycle of dental anxiety that begins with anxiety-related avoidance of dental care, followed by a subsequent deterioration in oral health and further consequences. Individuals who enter this vicious cycle more often seek treatment because of an existing oral problem rather than routinely visiting the dentist for regular examinations, which potentially may increase the dental anxiety caused by these acute invasive treatments [13]. Thus, as a consequence, patients with dental anxiety demonstrate greater functional impairment [14] and a reduced quality of life [14, 15]; this may have a negative effect on psychological well-being, social functioning, and vitality [16]. Numerous studies reported poorer oral health with more decayed teeth in patients with dental anxiety [17–19]. However, there are controversial findings as to whether dental anxiety affects periodontal health [19–23].

The purpose of this study was to investigate the correlation between dental anxiety and oral health, including dental and periodontal status. We hypothesized that patients with dental anxiety demonstrate both reduced dental and periodontal health.

Material and methods

Study cohort

A cross-sectional study was conducted in a practice-based setting (Gutersloh, Germany). An a priori sample size calculation (G*Power 3.01.10, Department of Psychology, University of Düsseldorf, Germany) was conducted to compute the needed sample size for a statistical power of 0.80. Data from a pilot study ($n = 50$ participants) was used, and the results suggested a sample size of 181 patients. In total, 200 patients were recruited and included.

Only patients (≥ 18 years) attending the dental practice for the first time were included. Patients with a history of periodontal treatment in the previous 6 months as well as patients in regular maintenance therapy were excluded.

An informed written consent was obtained from all participants. The protocol was approved from the Institutional Review Board of the Jena University Hospital (3836–07/13). The STROBE guideline for cross-sectional studies was used.

Modified dental anxiety scale

To measure dental anxiety, we used the modified dental anxiety scale (MDAS, German version) [24]. This scale includes a series of five questions to be presented to the participants as a questionnaire before clinical examination, and they were asked to rate the level of anxiety they would feel if they were in a particular dental situation. The response scale was not anxious (=1), slightly (=2), fairly (=3), very (=4), or extremely

anxious (=5) to the following questions: (Q1) If you had to go to the dentist tomorrow, how would you feel about it? (Q2) When you are waiting in the dentist's office for your turn in the chair, how do you feel? (Q3) If you were about to get a tooth drilled, how would you feel? (Q4) If you were about to have your teeth scaled and polished, how would you feel? (Q5) If you were about to have a local anesthetic injection in your gum, above an upper back tooth, how would you feel? The answers were summed up as MDAS. A MDA score of 19 was defined as the cutoff score for having dental anxiety [8].

Clinical data

The clinical data—probing depth (PD), clinical attachment loss (CAL), bleeding on probing (BoP), and the Silness-Loe plaque index [25] as well as the number of decayed, missing, and filled teeth of each subject were recorded as DMFT [26] by a single investigator. Patients with any clinical sign of periodontitis were assumed as a periodontitis case (at least two teeth with $PD \leq 4$ mm or one tooth with >4 mm PD) [27, 28].

Oral health-related behavior

Tooth flossing frequency was measured with response alternatives of daily, weekly, and never, using a questionnaire. The attendance of dental visits was questioned by whether it occurred within the last 2 years or not. If the last dental check-up was more than 2 years prior, this was rated as infrequent.

Statistics

The statistical analysis was conducted using SPSS 22 (IBM SPSS Statistics, NY, USA). Descriptive statistics, including the t test for comparison of scores within the cohort and Spearman's correlation coefficient as well as a logistic regression model were used for further data analysis. Cronbach's alpha was determined for the MDAS to verify the reliability of the questionnaire in the tested cohort. The level of significance was set as 5 %.

Results

Characterization of the cohort

The mean age of all participants was 49 ± 18 years. Data of 95 males and 105 females were analyzed. The DMFT in the study cohort was 16.1 ± 7.7 , with 2.2 ± 2.9 decayed teeth, 4.4 ± 5.8 missing teeth, and 9.6 ± 5.7 filled teeth, with an average of 23.2 ± 6.2 teeth per subject. Forty-five percent of the study cohort demonstrated any sign of periodontitis.

Periodontitis cases

A comparison of the clinical parameters showed as expected, significant differences between non-periodontitis and periodontitis cases ($p < 0.001$). However, the MDAS was comparable in periodontitis and non-periodontitis cases (Table 1). The risk estimation for subjects with dental anxiety and no signs of periodontitis resulted in an odds ratio of 0.988 (95 % CI 0.656–1.488) and for periodontitis of 1.010 (95 % CI 0.719–1.419), respectively.

MDAS questionnaire

Figure 1 summarizes the distribution of answers for the five MDAS questions. The MDAS questionnaire had a good reliability with a Cronbach’s alpha of 0.820. The participants rated teeth cleaning less anxiety inducing than the drilling or getting an injection. Over 50 % answered not being anxious if they were about to get their teeth cleaned, while only 22 or 31 % answered this for questions 3 (tooth drilled) or 5 (anesthetic injection), respectively. Of the 200 participants, 166 rated the five questions with being at least slightly anxious.

Dental anxiety

It was found that 20 of 200 participants could be categorized as having dental anxiety with a MDA score of 19 and greater. Sixty-five percent of these patients with dental anxiety were females; all subjects were younger than 65 years old. In comparison to patients without dental anxiety, more women ($p = 0.002$) and younger patients ($p = 0.023$) were found in the group with dental anxiety. Besides age and gender, dental anxiety was correlated with the inconsequent use of dental floss (MDAS <19 50 %; MDAS \geq 19 80 % never used dental floss; $p = 0.041$) and infrequent dental visits (MDAS <19 78 %; MDAS \geq 19 55 % dental visit within previous 2 years; $p = 0.001$).

Comparing the dental and periodontal status in patients with dental anxiety to those patients without dental anxiety demonstrated, there were no differences for probing depth and clinical attachment loss; however, patients with dental anxiety demonstrated more signs of gingival inflammation

measurable as BoP. Regarding dental status, patients with dental anxiety had less filled, but more decayed teeth. The DMFT was slightly but not significant higher in the dental anxiety group (Table 2).

Linear regression analysis was performed to identify predictors for dental anxiety in this German practice-based cohort. In the first regression model, decayed teeth were identified as predictors (std. beta = 0.40, $p < 0.001$) of dental anxiety. The following models indicated gender (std. beta = -0.18 , $p = 0.009$) and infrequent dental visits (std. beta = 0.14, $p = 0.047$) as reliable predictors.

Discussion

In this German practice-based sample, patients with dental anxiety had significantly more caries experience and gingival inflammation. Therefore, dental anxiety has a correlation with negative effects on dental and periodontal health. However, dental anxiety was not a relative risk for periodontitis. Dental anxiety was higher in women than in men, and the older the patient, the lower the dental anxiety scores. However, decayed teeth seem to play a greater role than periodontal destruction in patients with dental anxiety.

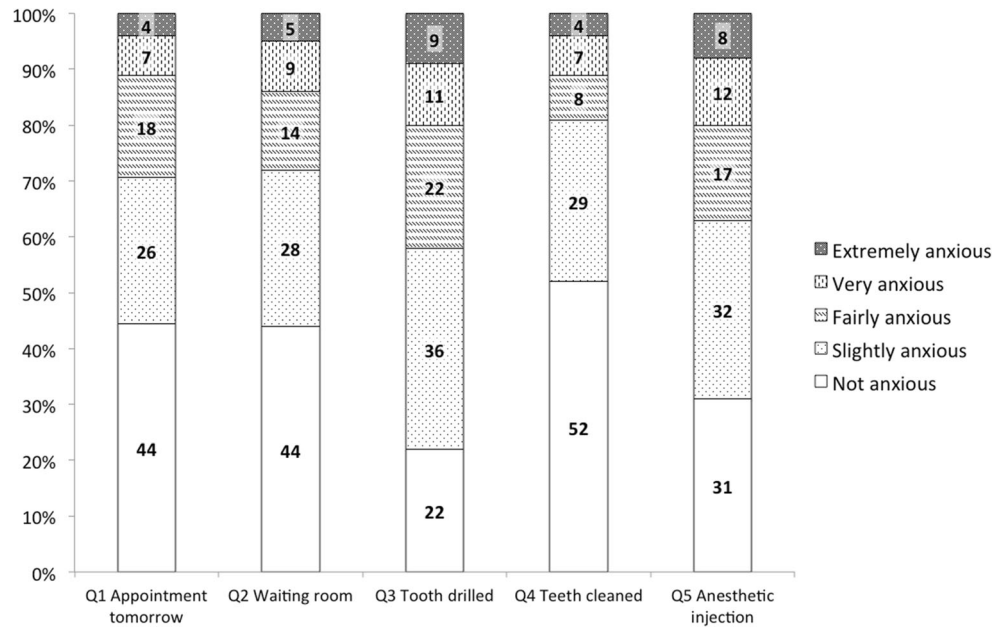
Our results suggest that patients with dental anxiety demonstrate more decayed but less filled teeth. This was confirmed by a report from Armfield and colleagues [17], who analyzed the data from 5364 adults aged 18–91 years old as part of the National Survey of Adult Oral Health (NSAOH) in Australia. This group found that individuals with higher dental fear have significantly more caries and missing teeth but less filled teeth. They underlined the importance of identifying and reducing dental fear as important steps in improving adult oral health.

While the literature seems to be consistent in the finding that dental anxiety is associated with more decayed teeth, the associations between dental anxiety and periodontal health are obscure. The NSAOH data showed that periodontitis and gingivitis were not associated with dental anxiety [17]. Delgado-Angulo et al. [19] also reported that anxiety was not related to the number of teeth with periodontal pocketing (PD \geq 4 mm). The authors

Table 1 Comparison of clinical periodontal parameters (as mean and standard deviation (SD)) of patients with and without signs of periodontitis. While the clinical parameters were significant different in both groups (each $p < 0.001$), the MDA scores were comparable (not significant different)

	Cohort ($n = 200$)	No periodontitis ($n = 110$)	Periodontitis ($n = 90$)	p values
PD mean (SD) in mm	2.2 (0.7)	1.8 (0.3)	2.6 (0.8)	<0.001
CAL mean (SD) in mm	4.1 (1.8)	2.8 (1.0)	5.1 (2.3)	<0.001
BoP mean (SD) in %	36 (20)	25 (14)	45 (29)	<0.001
MDAS	10.7 (5.1)	10.7 (5.2)	10.6 (5.0)	0.855

Fig. 1 Distribution of answers of the five-question MDAS questionnaire. Getting a tooth drilled (Q3) or getting an anesthetic injection (Q5) were the questions patients answered most frequent with being very or extremely anxious in comparison to getting the teeth scaled and polished (Q4)



investigated the data from the Health 2000 Survey, a nationally representative survey carried out in Finland, with 8028 participants aged 30 years and over in total, and 5401 dentate adults who were included in the secondary data analysis. They identified that depression but not anxiety was associated with periodontitis and the number of decayed teeth. Another epidemiological study in 374 male army soldiers aged 19 to 54 years in Germany identified that anxious patients had significantly more carious lesions, but showed no significant differences in periodontal status [29]. This is in agreement with the findings from Agdal et al. [18], who examined 40 patients diagnosed with dental anxiety and reported that in these patients, the treatment need caused by decayed teeth was significantly higher than for periodontal disease. However, there are also reports describing an association

of dental anxiety and poor periodontal health. An investigation in Poland illustrated that patients with dental anxiety showed more calculus, which can be a sign of decreased oral hygiene and the presence of gingivitis. Jamieson et al. [30] reported oral health impairment associated with untreated dental decay and the presence of periodontal pockets 4 mm and more in patients with dental fear. A recent paper published regarding the relationship of dental fear and periodontal status in 1203 Chinese adults described that the dental anxiety scores (the authors used the four-item Corah’s dental anxiety scale which is a predecessor of the MDAS) for patients with periodontal disease were significantly higher than for patients not suffering from periodontal disease [22]. Bell et al. [20] reported that in a rural older population, dental anxiety was associated with bleeding gums as signs of gingivitis. This is in agreement with the findings of the presented study, where we found significantly higher BoP values in patients with dental anxiety.

Table 2 Dental and periodontal status (as mean and standard deviation (SD)) of patients without and with dental anxiety. The cutoff of having dental anxiety was a MDAS of ≥ 19 (MDAS ranged from 5 to 25) [8]. Patients with DA showed more decayed but less filled teeth and had also more bleeding gums

	MDAS <19	MDAS ≥ 19	<i>p</i> values
PD mean (SD) in mm	2.3 (0.7)	2.4 (0.7)	0.499
CAL mean (SD) in mm	4.0 (2.0)	5.0 (2.8)	0.074
BoP mean (SD) in %	34 (20)	50 (19)	0.002
Plaque mean (SD)	2.5 (0.6)	2.7 (0.6)	0.291
Decayed teeth mean (SD)	1.7 (2.4)	6.7 (4.2)	<0.001
Missing teeth mean (SD)	4.3 (6.0)	4.6 (3.8)	0.842
Filled teeth mean (SD)	9.8 (5.7)	7.1 (4.5)	0.042
DMFT mean (SD)	15.8 (7.8)	18.4 (6.2)	0.151

Regular dental attendance is essential for maintaining good oral health. Regular attendees consider restorative treatments or manage tooth loss [31], while dental anxiety patients might perceive that dentists will only provide symptomatic care for their declining oral health, rather than a comprehensive treatment. This behavior is most likely related to their previous negatively perceived experiences [32]. Meng and others [5] have observed that dental anxiety patients were less likely to see a dentist for a check-up over the past 5 years and were more likely to delay scheduling a dental appointment and to be problem-oriented attenders. A study among Swedish women aged 38–54 years old showed that dental fear was associated with irregular dental utilization behaviors [33], and in Norwegian adolescents, dental fear was among the main

reasons for missed and canceled appointments [34]. However, Schuller et al. [35] reported that many subjects with dental anxiety visited dentists regularly. They also found no differences between low and high dental fear groups in daily personal dental care practices, such as the use of toothbrush, dental floss, and tooth picks. A secondary analysis of data from the Adult Dental Health Survey (ADHS) in the UK focused on oral health behaviors and outcomes between dental phobic and non-phobic participants. The authors found that the majority of phobic patients were women, and phobic patients in this cohort also demonstrated more teeth with active caries [36]. Further, they identified that individuals with dental anxiety showed attitudes of avoiding dental treatment. The ADHS data also suggests that patients with dental anxiety were more likely to smoke and brush their teeth less frequently. In line with these findings, infrequent dental visits within the last 2 years and no use of dental floss were identified as predictors for dental anxiety in the cohort of the presented analysis.

Dental anxiety is not only affecting patient's life negatively [6] but is also a challenge for dentists and their staff. Ignoring the problem and working fast to get the patient out of the chair might be the least optimal strategy. In fact, not to resolve a patient's anxiety can lengthen appointments, exacerbate pain perception, and reinforce negative attitude making subsequent appointments even worse [37]. Given the negative impact of dental anxiety on oral health, primary goal should be to prevent dental anxiety by the avoidance of negative experiences and the promotion of positive experiences for children, adolescents, and adults [38]. Several treatment options are available if a patient is diagnosed with dental anxiety. Non-pharmacological chairside techniques for reducing dental anxiety include (i) non-relaxation-based techniques (e.g., communication, distraction), (ii) quasi-relaxation-based techniques (e.g., guided imagery), and (iii) relaxation-based techniques (e.g., progressive relaxation, modified systematic desensitization, and hypnosis) for more anxious patients [37]. Pharmacological interventions are commonly used for highly anxious patients (e.g., premedication, N₂O, IV sedation) [38] but have risks for both the patient and sometimes for the staff [37] and should be administered only after careful evaluation.

The results of this study should be interpreted in light of its limitations. First, this study is cross-sectional, so it may only cover a snapshot of the overall population, but age and gender distribution as well as dental and periodontal findings are comparable to the observations of the German Oral Health Study IV [39]. This study included just one measure of dental anxiety, the MDAS, but previous studies demonstrated the strength and validity of this tool [8, 24], and Cronbach's alpha greater than 0.8 in this study confirms the good reliability of this questionnaire. Finally, we acknowledge that oral health-related behaviors were self-reported, but there is no other cited method of recording this. Nonetheless, this study has a

number of strengths, including a representative cohort, a real-life setting in a private dental office, standardized measures of dental anxiety, and clinical examinations performed by a single investigator.

Conclusions

Dental anxiety seems to have an association with negative effects on dental and periodontal health. In this cross-sectional study in a German practice-based setting, patients with dental anxiety demonstrated more decayed but less filled teeth and bleeding gums more frequently; therefore, oral health in these patients was compromised. Decayed teeth, gender, and infrequent dental visits were predictors of higher ratings of dental anxiety. The findings of this study suggest that identifying patients with dental anxiety is a crucial and significant step towards oral health improvement in such populations.

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Compliance with ethical standards

Conflict of interest Arndt Guentsch declares that he has no conflict of interest. Christiane Stier declares that she has no conflict of interest. Mina Fahmy declares that he has no conflict of interest. Gregor Raschke declares that he has no conflict of interest. André Peisker declares that he has no conflict of interest. Harald Kuepper declares that he has no conflict of interest. Ina Schueler declares that she has no conflict of interest.

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Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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